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To Mr. J.V. Doyle
Manager
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Thermal and Hydraulic Generation Division

Attn: Mr. I. Azis

DECEW FALLS GS
NEW GEOTECHNICAL INSTRUMENTATION

C.B.H. Cragg

Piezometers, observation wells and survey monuments were installed at DeCew Falls GS. Locations and installation details for these instruments are summarized in this report.

1.0 INTRODUCTION

A review of the instrumentation at DeCew Falls GS recommended that new piezometers, observation wells and survey monuments be installed/1/. All the recommended instruments, except a weir near the penstock saddle, were installed. This field work took place in October and November of 1986 and was performed at the request of the Civil Works Department. A soils investigation was performed at the same time as the instrument installations were done. This report documents the instrumentation aspects of this project. The soils investigation results will be reported separately.

2.0 INSTRUMENTS INSTALLED

The following instruments were installed:

(a) 9 piezometers

(b) 4 observation wells

(c) 7 survey brass caps

(d) 8 survey iron bars

Locations and construction details are described below.

job	file	date	report no.
43-147-575	843.12	February 24, 1987	86-325-K

2.1 Piezometers

Eight piezometers were installed in the Forebay dykes (Figure 1) and one was installed in the Waterworks Canal dykes (Figure 2). All piezometers were reconstructed of 1.5 inch diameter schedule 80 PVC pipe with the top 2 feet reduced to 1 inch pipe and the lower 3 feet perforated and wrapped with a geotextile. The borehole annulus was backfilled with silica sand to just above the standpipe perforations, then bentonite gravel was used to complete backfilling to the ground surface. Heavy duty plastic pipes with threaded cover plates were placed over the standpipes for protection. The tops of the protective pipes are located just below grade and covered with loose soil to avoid vandalism. A metal bar was driven beside each piezometer to aid in locating them for readings. Figure 3 shows typical piezometer construction details.

Piezometers 1 and 6 extend 5 feet into the rock below the dyke, as shown in Figure 4. Piezometers 2, 4 and 7 terminate in the natural clay till stratum. Piezometers 3 and 5 sense the water level in the old dyke fill which dates from the 1890's. These piezometers provide two phreatic cross sections of the dyke, with one section consisting of piezometers 1, 2 and 3 and the second section consisting of piezometers 4, 5, 6 and 7. Piezometer 8 terminates in the Waterworks Canal dyke fill downstream of a concrete cutoff wall (Figure 5). The depths of these piezometers range from 25 to 40 feet. Piezometer 9 extends through new dyke fill to the top of the former waste weir at a depth of 10 feet. Piezometer depths, top elevations and initial water levels are summarized in Table I.

2.2 Observation Wells

Four observation wells were drilled through the ND-1 headgate structure at the locations shown in Figure 6. These observation wells extend 30 feet into the rock below the structure (Figure 7). As shown in the drill logs (Figures 8 to 11), the rock below the headgate is predominantly limestone. A layer of sandstone was found immediately below the concrete in observation wells 2 and 3 (Figures 9 and 10). In observation well 4 (Figure 11), a gap of about 3 inches was encountered between the rock and the base of the concrete structure. The rock in all locations, including this gap, appears to be tight as no loss of water occurred during drilling. Some loss of water did occur through the concrete of the penstock walls when drilling was temporarily stopped in the concrete. Packers were therefore installed in these holes to separate water levels in the rock from those in the structure. Packer depths and water levels are shown in Table III.

The observation wells were covered by steel plates which are anchor bolted to the deck of the headgate structure.

2.3 Survey Monuments

Six brass cap survey monuments were installed in the ND-1 headworks and adjacent retaining wall to measure deformation of the retaining wall by alignment survey. Figure 1 shows the locations of these monuments. The two monuments on the headworks are intended to act as the reference points

for alignment measurements on the retaining wall monuments. Initial readings on these monuments will be done by Civil Works.

Eight survey bars were placed in the dyke fill over the former Waste Weir to monitor settlement of the fill. The locations of these bars and a reference benchmark (brass cap), atop one of the weir concrete piers, are shown in Figure 12. Initial elevations of the bars and benchmark are summarized in Table II.

2.4 Inclinometer

During investigation of a slope failure earlier this year/2/, plastic inclinometer casing was installed in the Waterworks Canal dyke. This 2.75 inch OD inclinometer casing is located on the upstream side of the dyke 12 feet from the road centreline and 6 feet downstream of the Bell cable duct. A plastic protective pipe, similar to that used for the piezometers, covers this instrument. The inclinometer extends to a depth of about 40.5 feet of which the lower 5 feet is in limestone bedrock.

3.0 SUMMARY

Piezometers, observation wells and survey monuments have been installed around the reservoir at DeCew Falls GS. Locations, construction details and initial readings were documented. Minor items remaining to be done at the time of writing this report are: placing soil cover over piezometer locations and initial survey on alignment monuments.

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REFERENCES

1. Cragg, C.B.H. "DeCew Falls GS Instrumentation Review - 1986". Research Division Report No S86-37-K, 1986.

2. Toth, P.S. "DeCew GS Headpond Slope Stability Investigation". Research Division Report No 86-251-K, 1986.

TABLE I

DeCew Falls GS
Piezometer Data Summary

Piezometer Number	Depth (feet)	Top Elevation (feet)[X]	Water Level Nov 10/86 (feet)*	Material at Well Screen	Location
1	40.6	560.8	540.2	rock	Top of Forebay Dyke
2	38.5	560.5	540.1	till	Top of Forebay Dyke
3	24.5	562.2	541.0	old fill	Top of Forebay Dyke
4	35.0	560.4	548.8	till	Top of Forebay Dyke
5	25.0	561.7	552.6	old fill	Top of Forebay Dyke
6	40.5	560.6	538.4	rock	Top of Forebay Dyke
7	15.0	540.3	-	till	Toe of Forebay Dyke
8	35.0	562.1	542.8	old fill	Top of Waterworks Canal Dyke
9	10.0	560.3	dry	new fill	Top of Forebay Dyke (over Waste Weir)

*Headpond Level (Nov 10/86) = 554.40 feet
[X]reference point for Top Elevation and Water Level is the top of the 1 inch PVC piezometer casing

TABLE II

DeCew Falls GS
Initial Elevations of Settlement Points Over Waste Weir

Station	Elevation (feet) Nov 10/86*
1	560.19
2	561.09
3	560.24
4	560.63
5	560.61
6	560.21
7	560.49
8	560.86
Benchmark (brass cap)	556.97

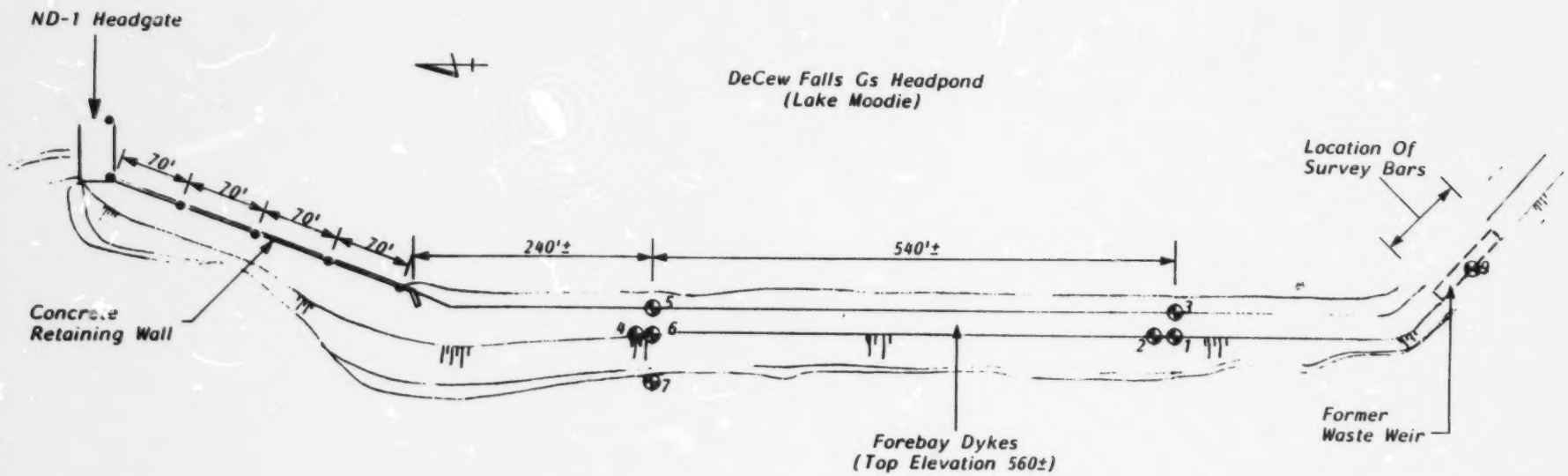
*elevations surveyed relative to headpond level on Nov 10/86

TABLE III

DeCew Falls GS
ND1 Observation Wells

Well No	Packer Depth (ft)	Water Level (ft)	
		Initial	After Packer Installed*
1	33.8	28.5	28.3
2	25.9	18.7	not taken
3	26.0	18.9	17.6
4	34.0	30.6	not taken

*readings taken on Jan 7/87 - 24 hours after packers installed (readings not taken on packers installed Jan 7/87)



• Brass Cap Survey Monuments

6 ⊕ Borehole And Piezometer Location (Based On Dwg. No. 47-e-337)

FIGURE 1

DECEW FALLS GS
INSTRUMENT LOCATIONS ON
FOREBAY DYKES

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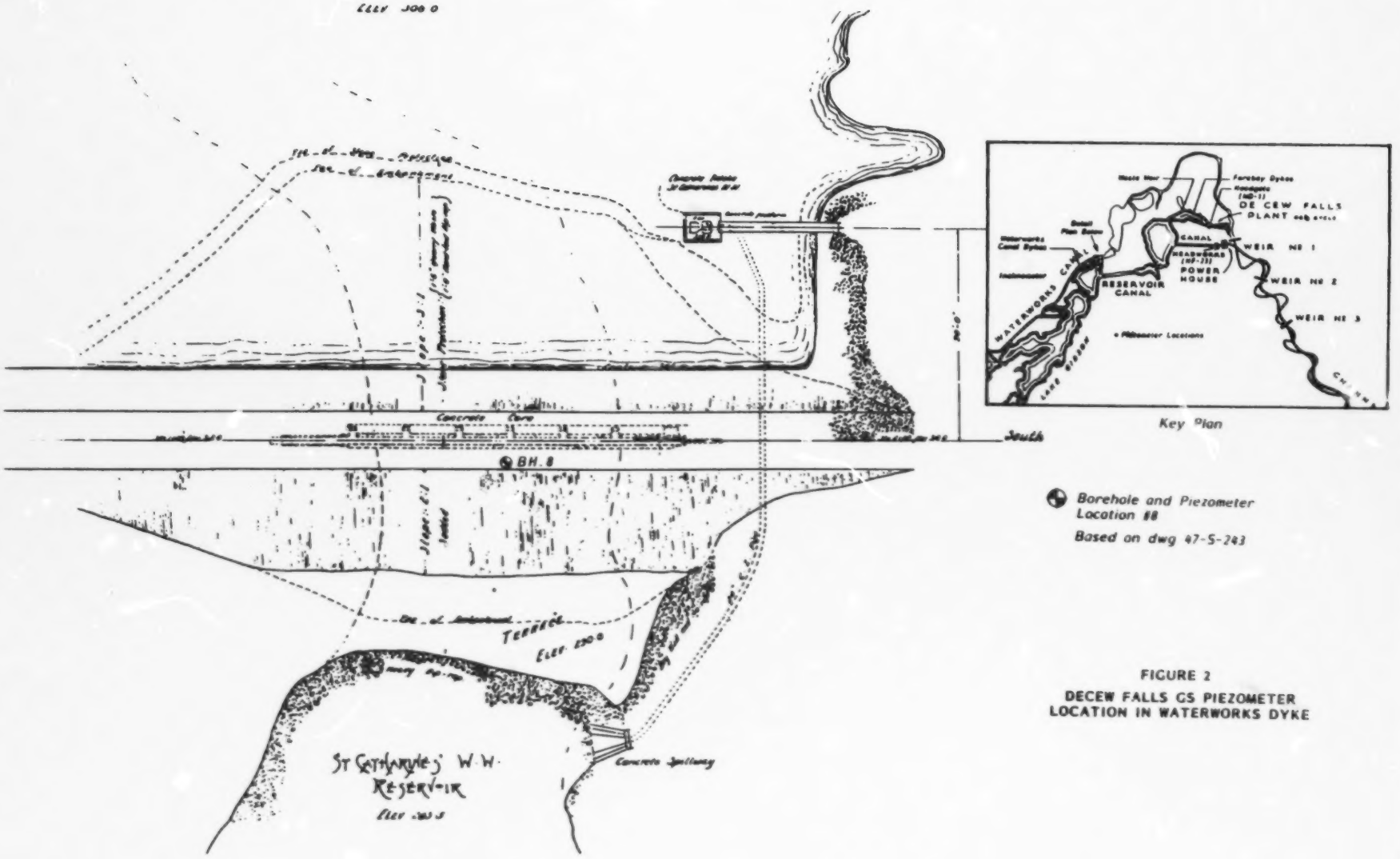


Borehole and Piezometer Location #8

Based on dwg 47-S-243

FIGURE 2

DECEW FALLS GS PIEZOMETER LOCATION IN WATERWORKS DYKE

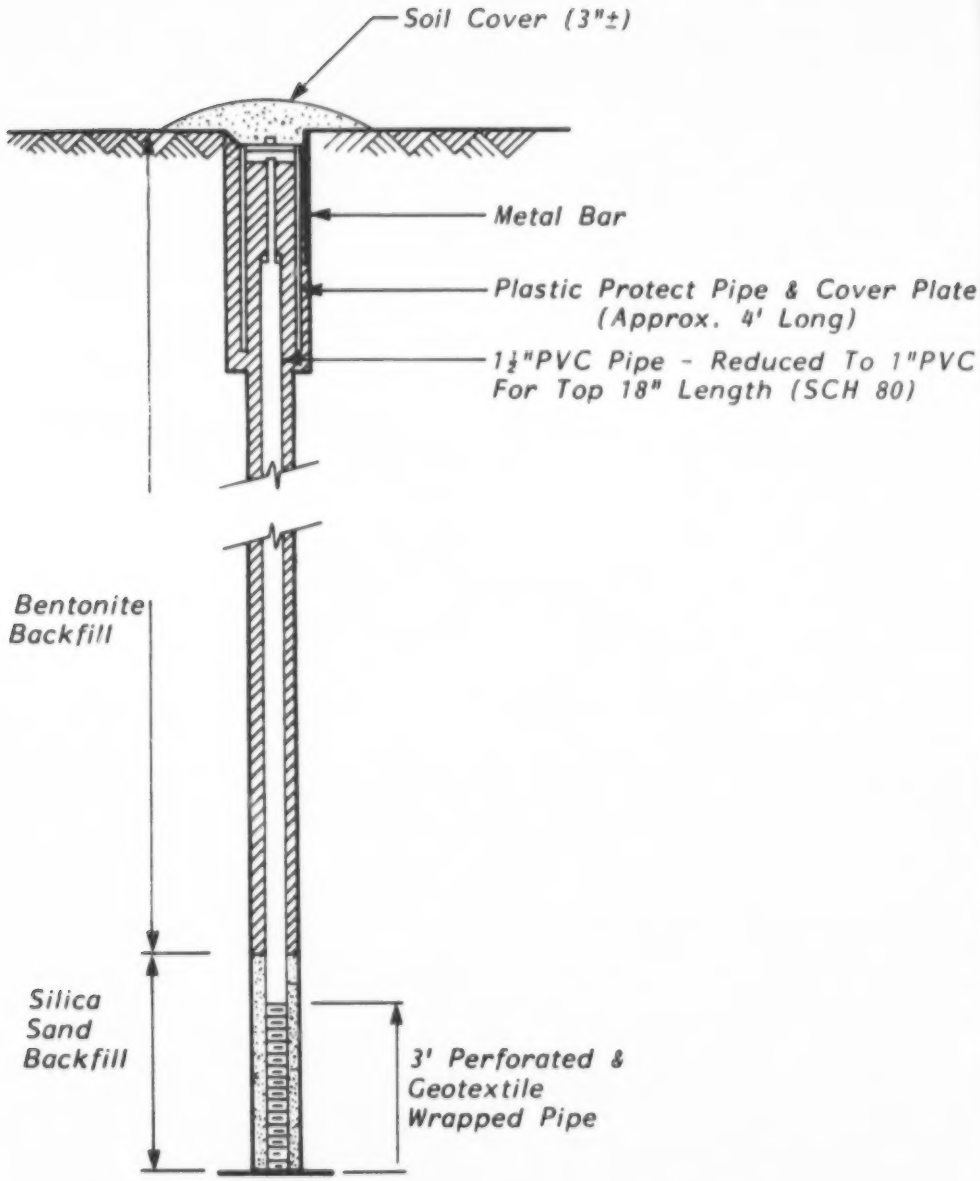


FIGURE 3
TYPICAL PIEZOMETER CONSTRUCTION

173302-RD

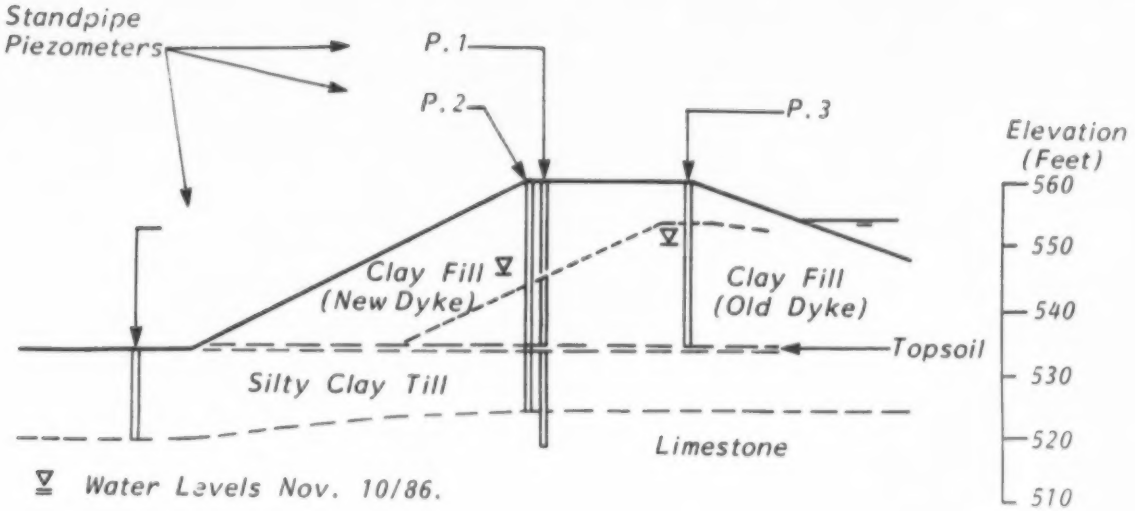


FIGURE 4A

DECEW FALLS GS FOREBAY DYKES
CROSS SECTION OF PIEZOMETERS

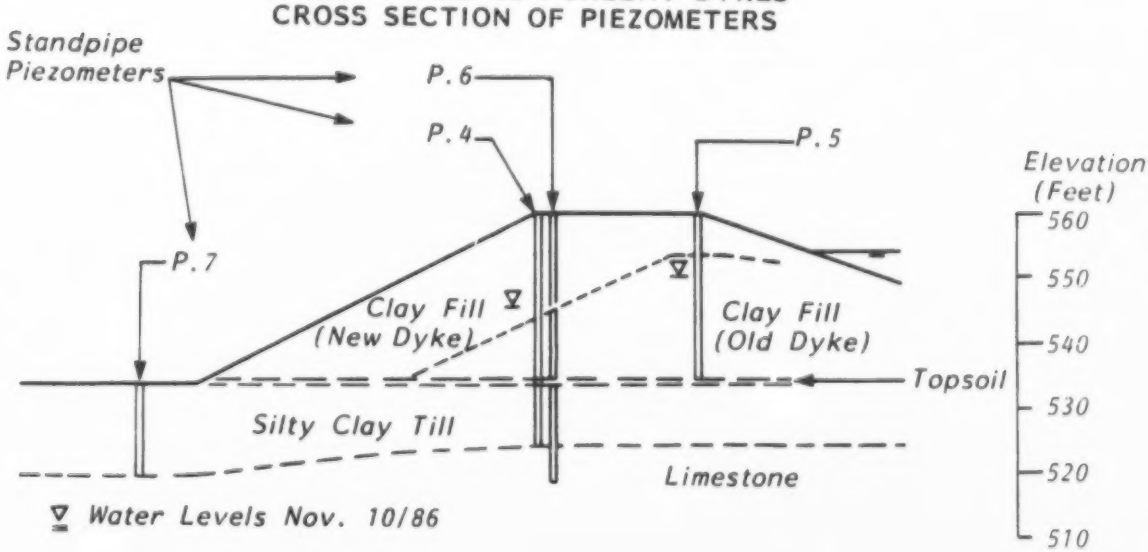
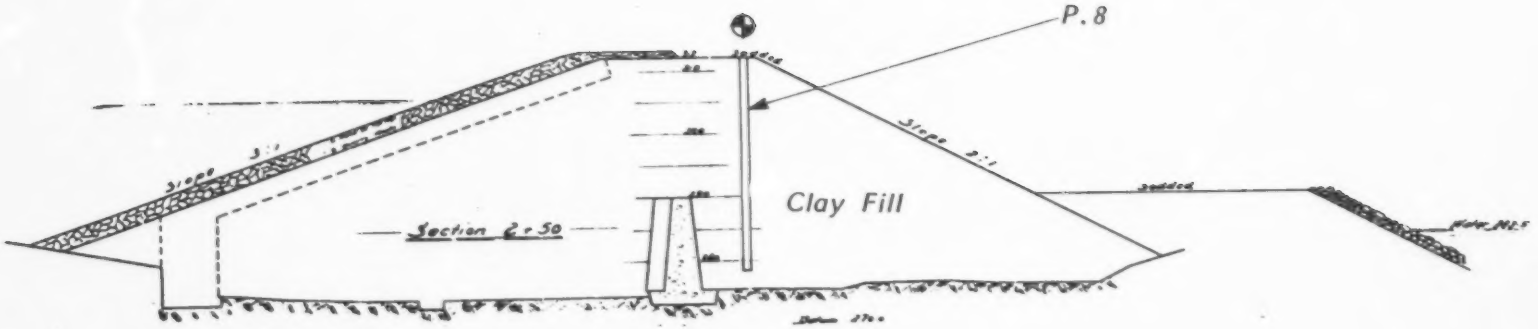


FIGURE 4B

DECEW FALLS GS FOREBAY DYKES
CROSS SECTION OF PIEZOMETERS

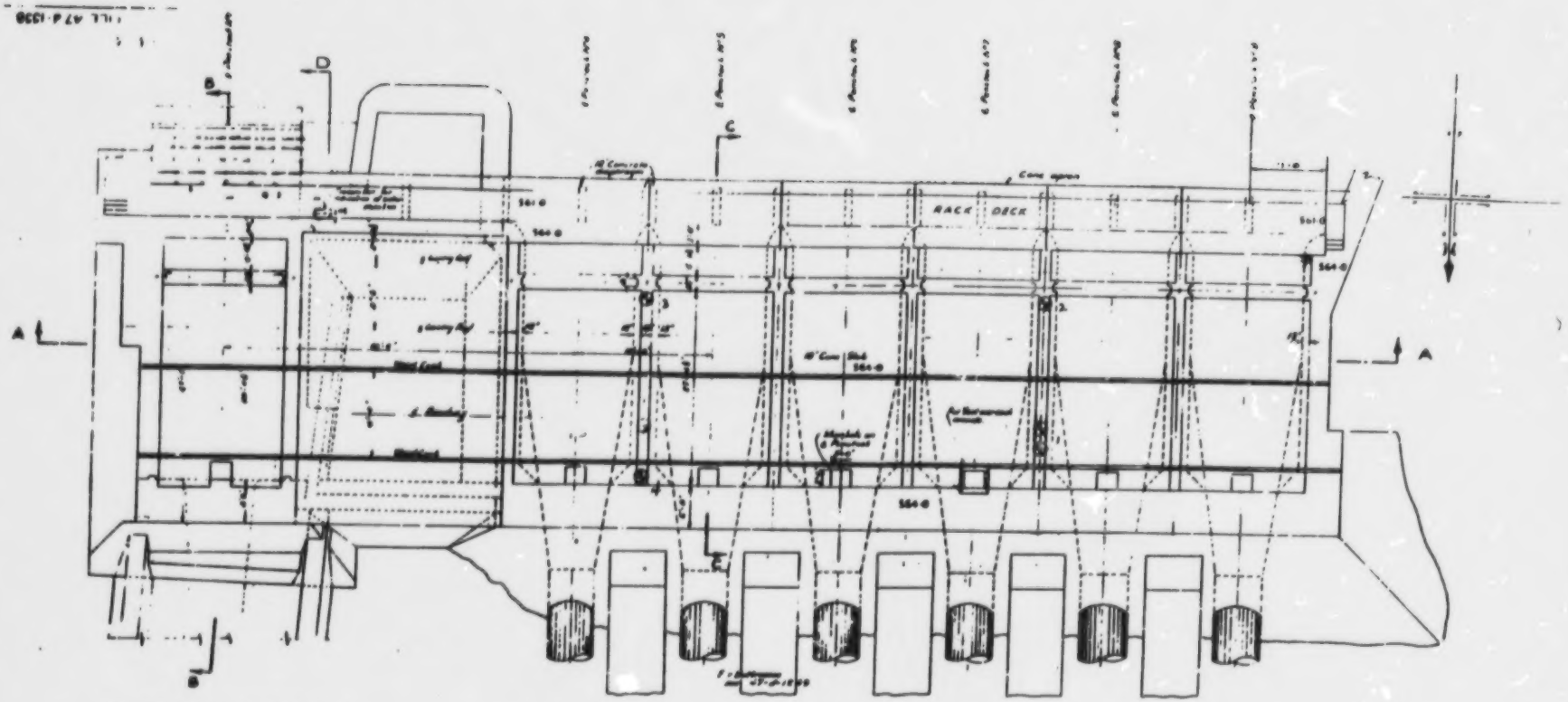


Piezometer And
Borehole Location #8

FIGURE 5

DECEW FALLS GS
SECTION OF WATERWORKS
CANAL DYKE

173305-RD



Observation Well And Drill Hole Location #2

Based On Dwg. No 47-J-1558

FIGURE 6
DE CEW FALLS GS ND-1 HEAD WORKS
PLAN OF OBSERVATION WELLS

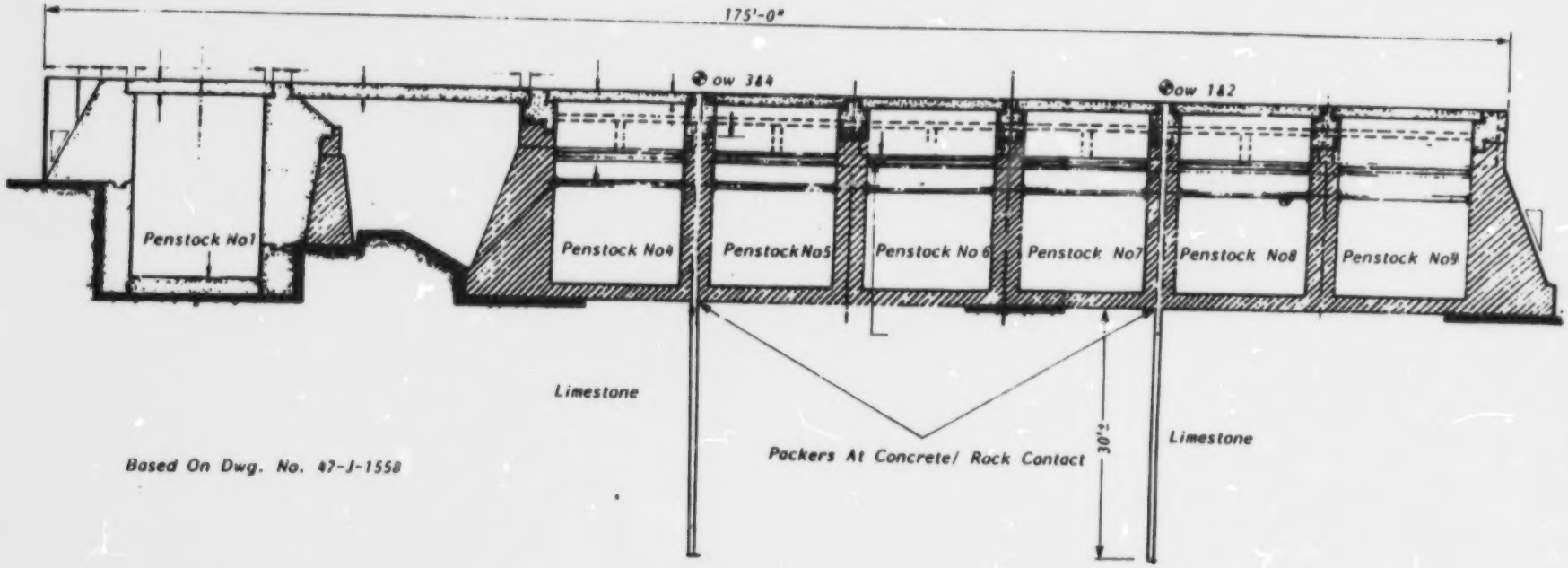


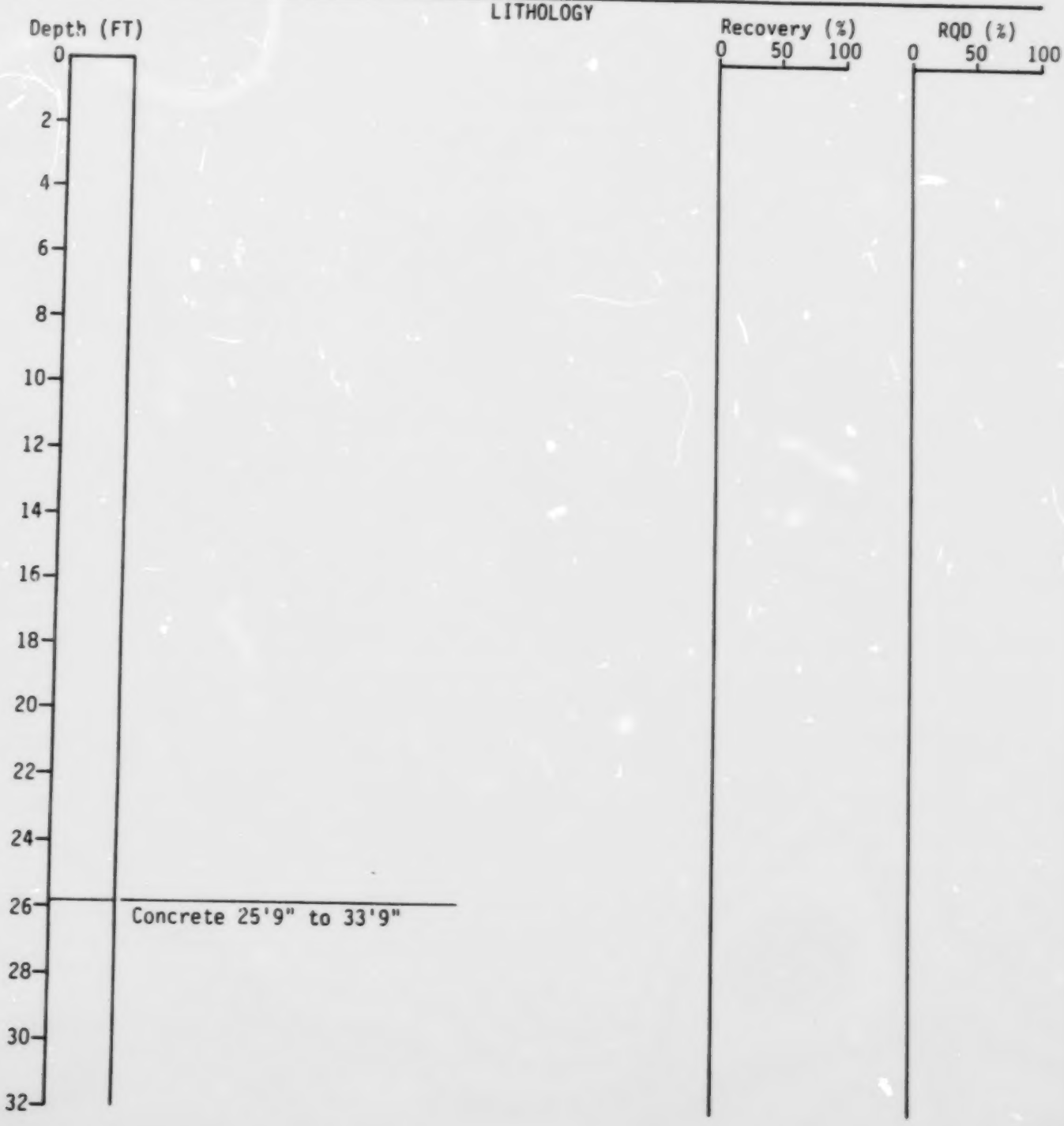
FIGURE 7
DECEW FALLS GS
SECTION OF ND-1 HEAD WORKS

FIGURE

BEDROCK LITHOLOGY

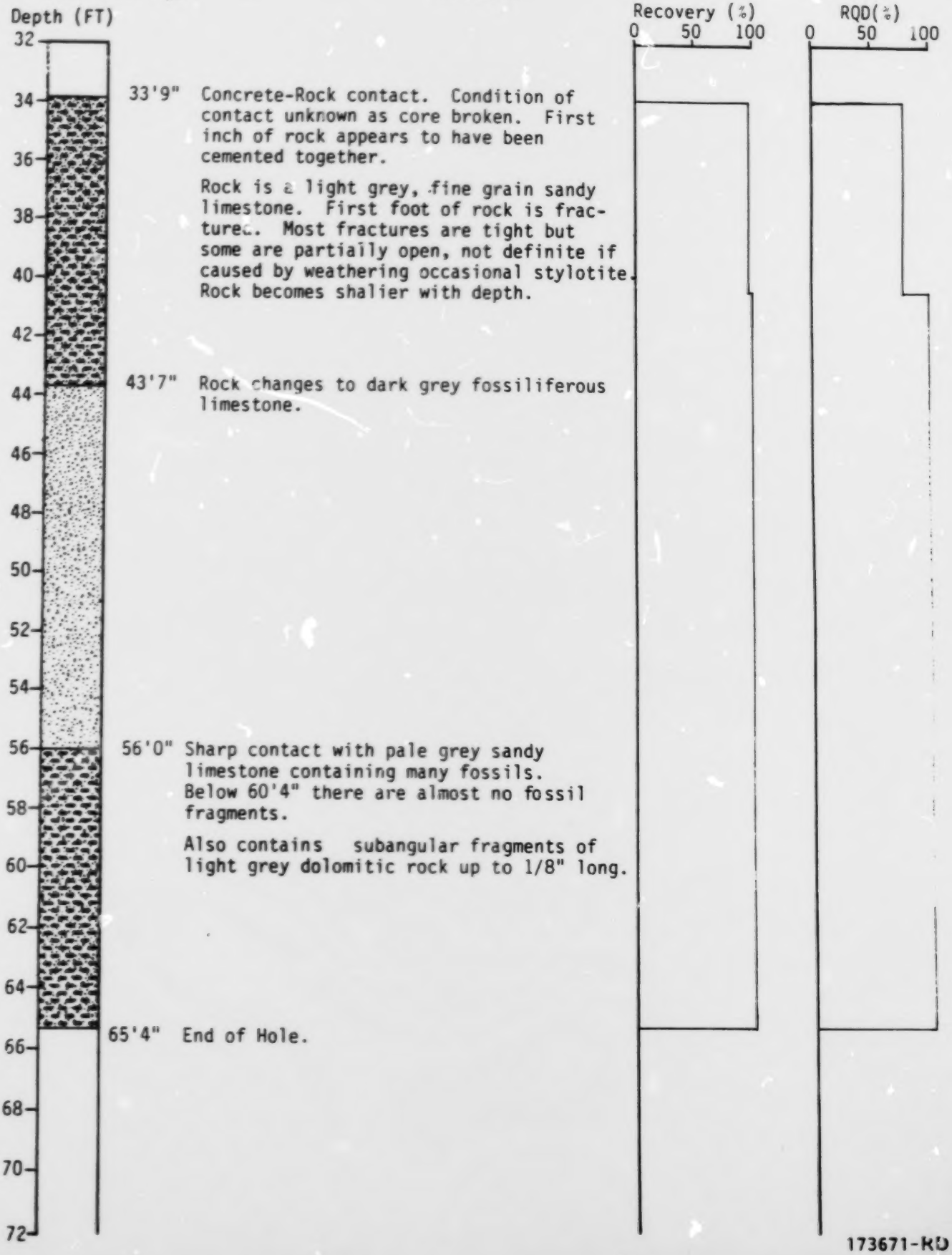
Project: DeCew
Borehole No.: NQ1

Location:
Chainage:
Collar Elev.:
Dip:
Azimuth:



Project: DeCew
Borehole No.: NQ1

LITHOLOGY



33'9" Concrete-Rock contact. Condition of contact unknown as core broken. First inch of rock appears to have been cemented together.

Rock is a light grey, fine grain sandy limestone. First foot of rock is fractured. Most fractures are tight but some are partially open, not definite if caused by weathering occasional stylotite. Rock becomes shalier with depth.

43'7" Rock changes to dark grey fossiliferous limestone.

56'0" Sharp contact with pale grey sandy limestone containing many fossils. Below 60'4" there are almost no fossil fragments.

Also contains subangular fragments of light grey dolomitic rock up to 1/8" long.

65'4" End of Hole.

173671-RD

FIGURE 9

BEDROCK LITHOLOGY

Project: DeCew
Borehole No.: NQ2

Location:
Chainage:
Collar Elev.:
Dip:
Azimuth:

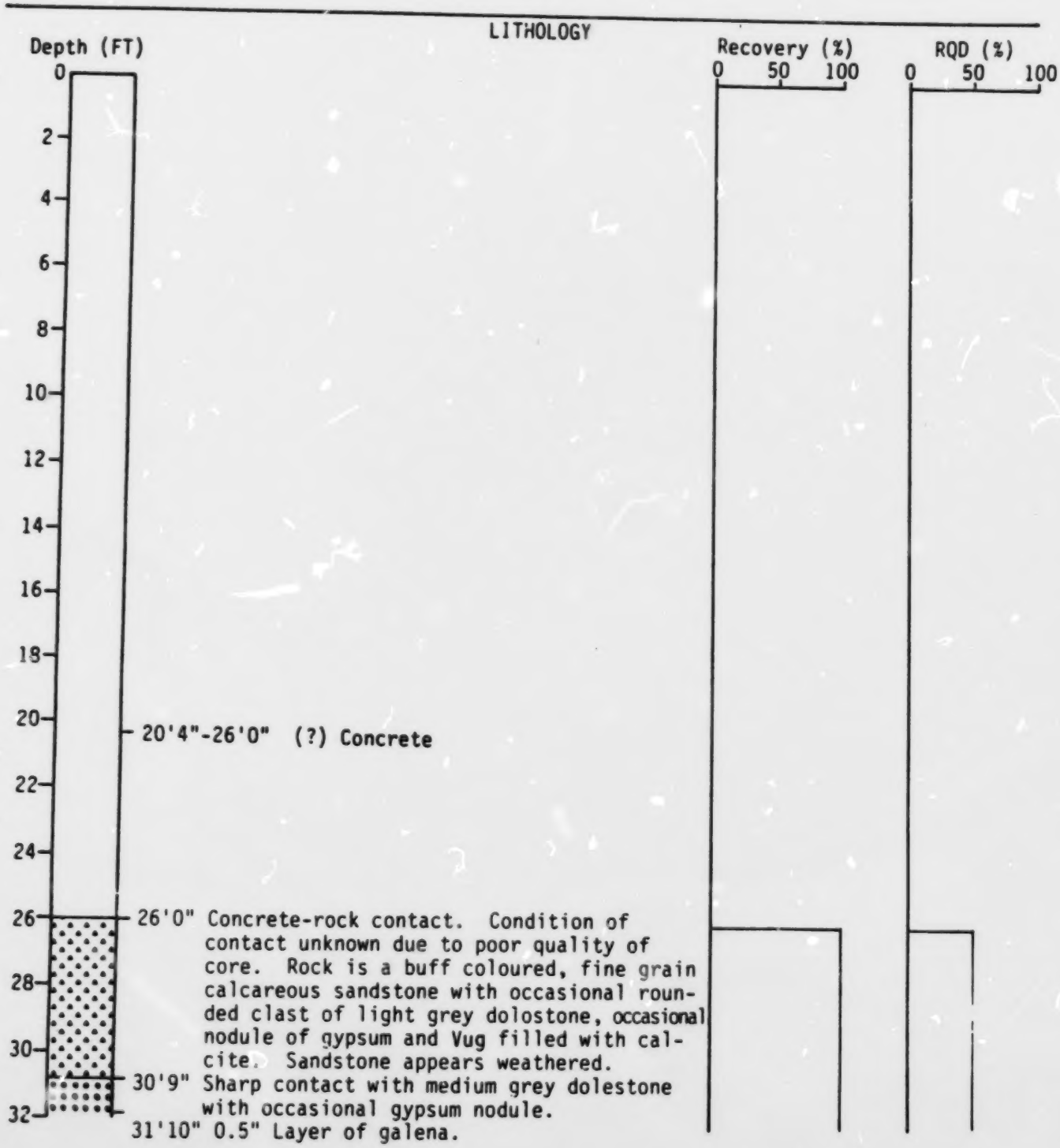
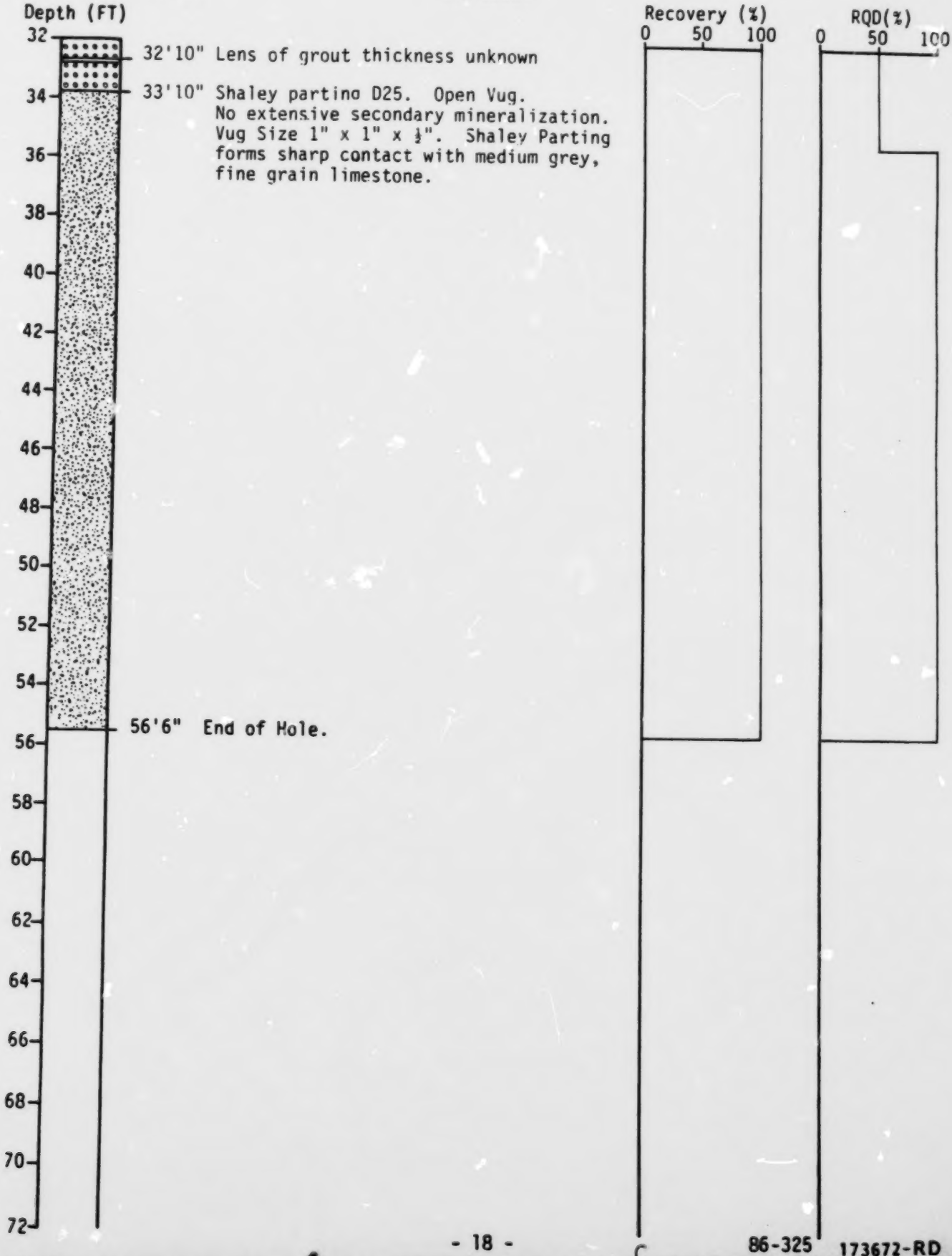


FIGURE 9 CONT'D

Project: DeCew
Borehole No.: NQ2

LITHOLOGY



32'10" Lens of grout thickness unknown

33'10" Shaley partino D25. Open Vug.
No extensive secondary mineralization.
Vug Size 1" x 1" x ½". Shaley Parting
forms sharp contact with medium grey,
fine grain limestone.

56'6" End of Hole.

FIGURE

BEDROCK LITHOLOGY

Project: DeCew
Borehole No.: NQ3

Location:
Chainage:
Collar Elev.:
Dip:
Azimuth:

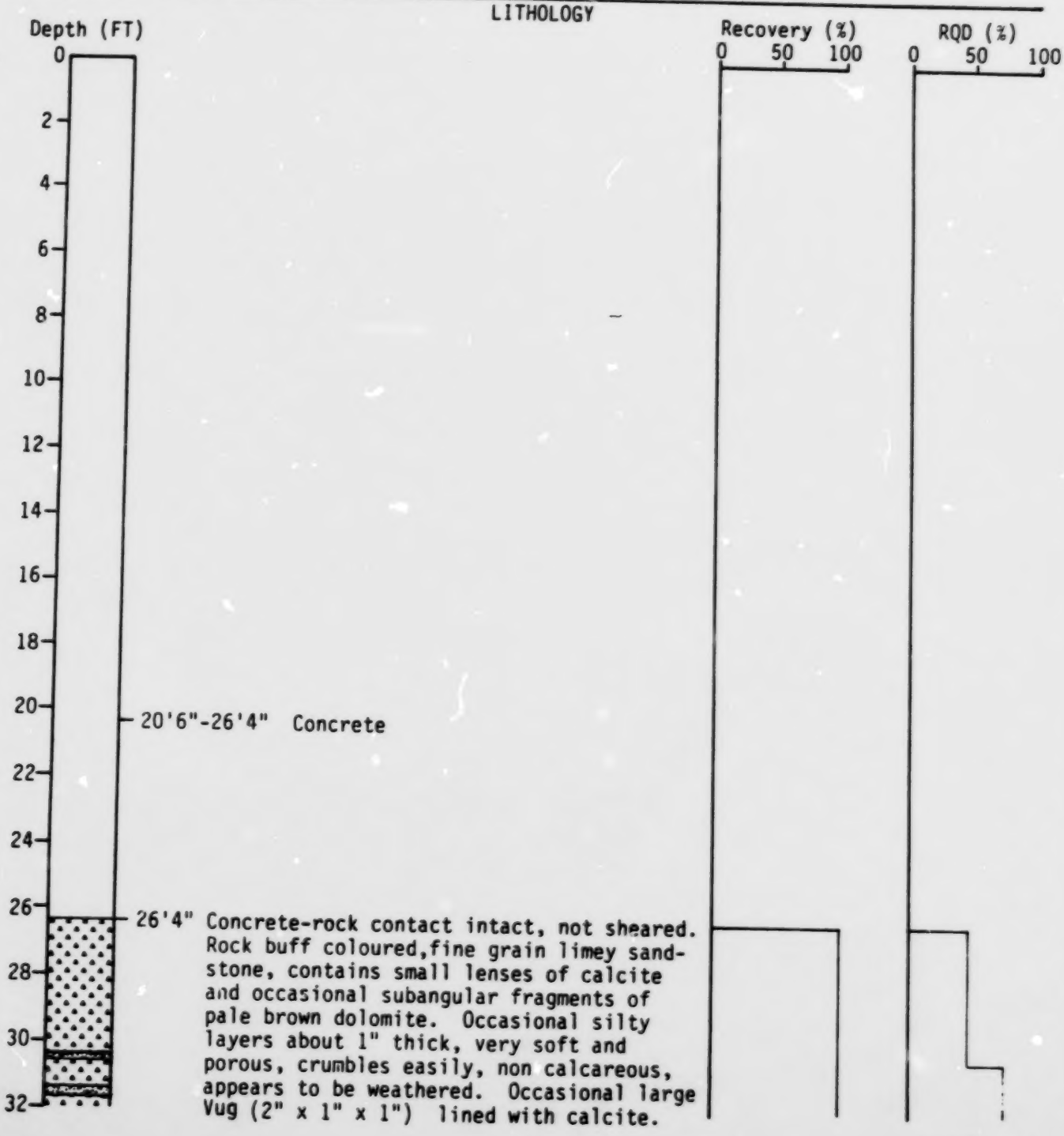


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FIGURE 10 CONT'D

Project: DeCew
Borehole No.:NQ3

LITHOLOGY

Depth (FT)

32 — 28'7"-28'8" Core badly broken. Appears to be large silty layer.
30'4"-30'5" Dark grey limestone
34 — 30'5"-31'4" Sandstone
31'4"-31'9" Limestone
31'9"-32'6" Sandstone with large Vugs (2"x1"x1") lined with calcite and gypsum. Below 32'6" limestone becomes dolomitic.
36 — 33'2"-34'6" Vertical fracture in core. No mineralization.
38 — 34'6" Stylolite - below this depth rock becomes limier.
40 — 40'5" Rock becomes shalier, grades into shaley limestone.
42 — 43.9" Rock becomes dary grey shaley limestone to end of hole.
44 —
46 —
48 —
50 —
52 —
54 —
55'6" End of Hole.
56 —
58 —
60 —
62 —
64 —
66 —
68 —
70 —
72 —

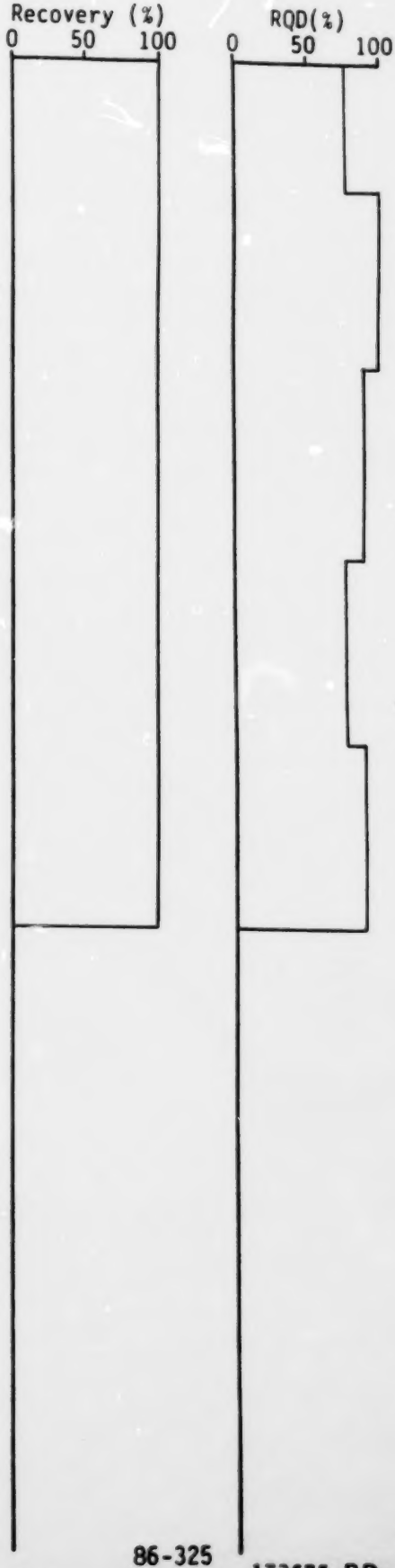

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FIGURE 11

BEDROCK LITHOLOGY

Project: DeCew
Borehole No.: NQ4

Location:
Chainage:
Collar Elev.:
Dip:
Azimuth:

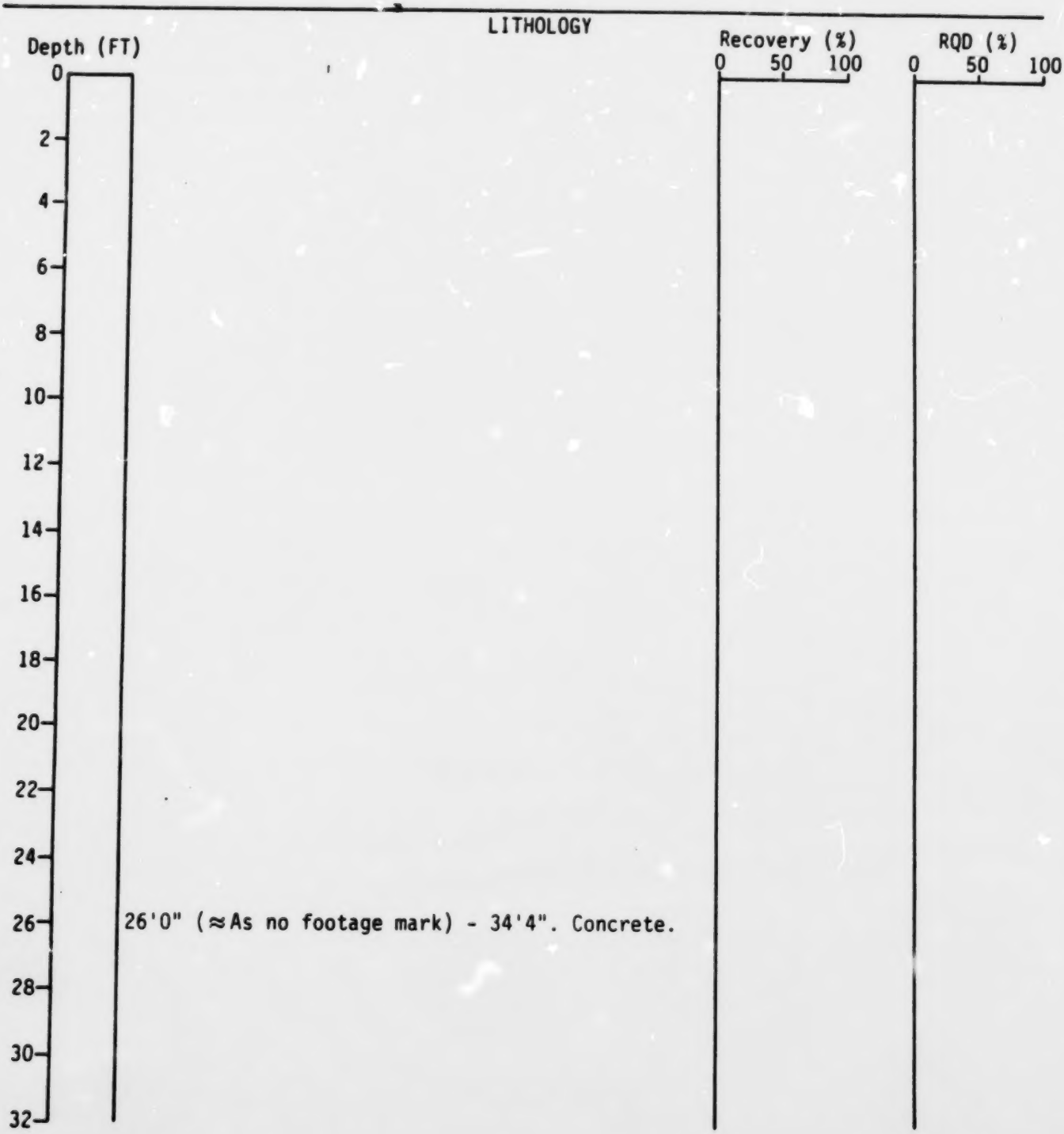
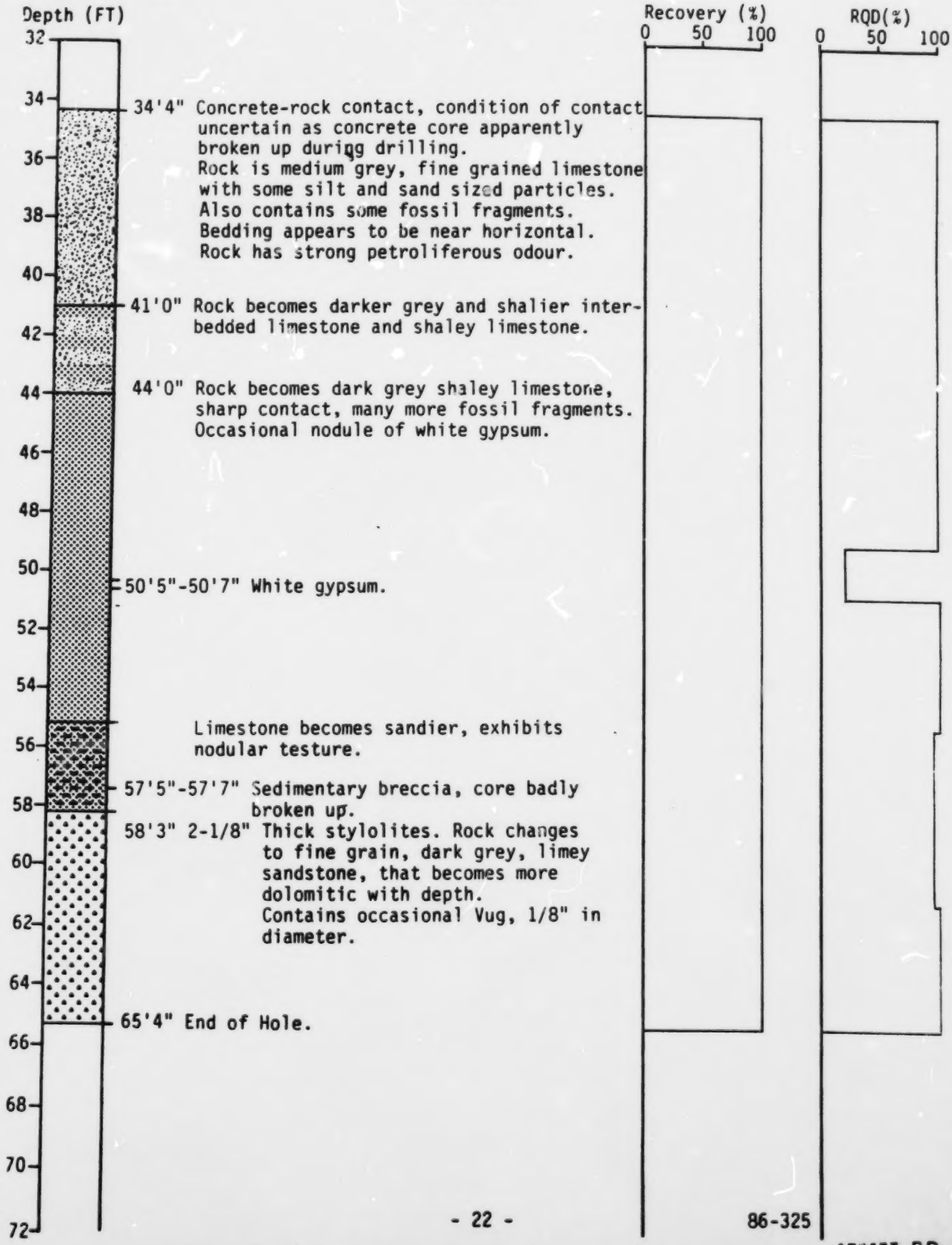


FIGURE 11 CONT'D

Project: DeCew
Borehole No.:NQ4

LITHOLOGY



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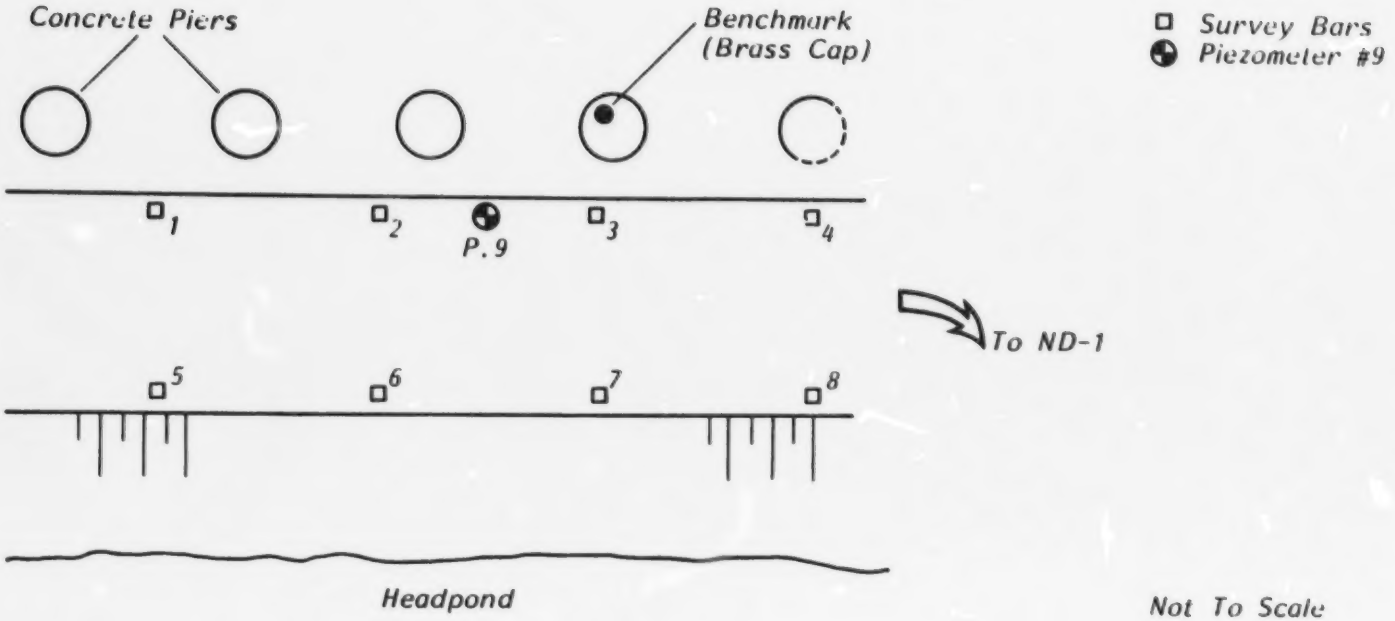

FIGURE 12

LOCATION OF SURVEY POINTS
OVER WASTE WEIR (DECEW FALLS GS)

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GEOLOGIC KEY

Limestone

Sandy Limestone

Shaley Limestone

Sandy, Shaley Limestone

Dolostone

Sandstone

Metamorphosed Sandstone

Marble

Banded Grey Marble

No Core

D — *Dip of a Feature*

DD — *Directional of Dip of A Feature with Respect to the Direction in which the Principal Geologic Feature such as Bedding of Metamorphic Banding*

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